

TERTIARY BIRDS FROM LAGUNA HILLS, ORANGE COUNTY, CALIFORNIA

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ABSTRACT: Approximately 120 of more than 200 avian bone fragments collected from one locality in Leisure World, Laguna Hills, California, can be given family assignment. At least 19 species are represented, but only nine are specifically assigned, even on a tentative basis. One genus and four species are newly described. The avifauna does not relate to that of any one of the other Tertiary localities in southern California, but individual species show greater resemblance to those of Middle and Late Miocene than to those of the Pliocene.

INTRODUCTION

Marine deposits in the Laguna Hills area of Orange County, California, have yielded fish, bird and mammal fossils of possibly two epochs of the Tertiary. As previously noted (Howard, 1966a), remains of the Pliocene flightless auk, *Mancalla*, occur at two sites, whereas a distinctly less specialized, possibly ancestral mancallid, genus *Praemancalla*, is found in association with Miocene desmostylian remains at a third locality, Los Angeles County Museum of Natural History (LACM) Vertebrate Paleontology locality no. 1945. The sites lie within the senior citizens' community of Leisure World, about a mile and a quarter southwest of the town of El Toro. LACM locality 1945 is approximately one-quarter mile north of Aliso Creek, which, in this area, runs in a southwest direction; the other localities (now listed as LACM 65120 and 65121) are at a somewhat higher elevation south of the creek and slightly east of LACM 1945. The three localities were uncovered for a short time only, as hillsides were cut away and excavations made for the development of new units of the community. Since one site was closed to view before another was revealed, stratigraphic studies have been incomplete.

Most of the bones from LACM locality 1945 are highly mineralized, smooth-textured, and of dark brown or brownish gray color. A few bones are markedly water-worn and have adhering to them a hard matrix, different from the surrounding sediments. Three or four bones of lighter color and rougher texture are seemingly less mineralized than the others. At localities LACM 65120 and 65121, most of the bones are light in color, often mottled, and of rough, uneven surface.

Locality LACM 1945: The present study is confined to the specimens recovered from LACM locality 1945. The main collections were made by the museum in August and December, 1964, with some additions up to the time the site became unavailable, during January, 1965. As listed in the LACM records, field data for this locality read as follows: "1¼ miles SW of the town of El Toro; ¼ mile N of Aliso Creek, on the property of Leisure World Co.,

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Figure 1. Excavations at LACM locality 1945, Leisure World, December, 1964.

SW/4 of NE/4 of SW/4, Sec. 34, T 6 S, R 8 W, Orange County, Calif., San Juan Capistrano quadrangle." The field notes of Mr. W. Earl Calhoun, whose watchfulness during building operations made possible much of the fossil collecting, supply the following information regarding the location of the site with respect to the present street and building pattern at Leisure World: "Strata run in a line between Bldg. 221 on one side and Bldgs. 211 to 216 on the other side in a north-south direction, dropping approx. 15° to east." The best locality for bird bones was at the northwest side of building 215 Avenida Majorca. (See Fig. 1.)

Acknowledgments: The Museum is grateful to Mr. Ross W. Cortese and Rossmoor Leisure World, Laguna Hills, for the opportunity to collect while work was under way for new units. We are particularly appreciative of the efforts of Mr. W. Earl Calhoun in our behalf; and our thanks go, also, to the several unknown residents who turned over specimens for the benefit of the Museum.

The type of *Eremochen russelli* was available on loan through the courtesy of the University of Oregon. Recent skeletons of *Aethia*, *Cyclorhynchus* and *Plautus* were kindly loaned by the California Museum of Vertebrate Zoology, Berkeley, Calif., and the United States National Museum.

Photographs were made by Mr. Mike Hatchimonji, Senior Photographer, Los Angeles County Museum of Natural History.

MATERIAL AVAILABLE

Approximately 200 bones are included in the avian collection from LACM locality 1945. Of these, 120 can be identified within four orders, and six families. At least 19 species are represented. Four of these, including a new genus, are herein described, making a total of five new species and two new genera typical of this locality (including *Praemancalla lagunensis* Howard, 1966). Four species are at least tentatively assigned to forms previously

described from other Tertiary localities in southern California. Others are identified only to family or genus.

For bibliographic reference to the related fossil species described from other areas, and the location of the types, the reader is referred to the Catalogue of Fossil Birds (Brodkorb, 1963, 1964, 1967). In addition to the LACM types listed, the LACM collections include casts of types of the following species: *Puffinus priscus*, *P. mitchelli*, *P. inceptor*, *P. conradi*, *P. diatomicus*, *Sula willetti*, *Miosula media*, *Palaeosula stocktoni*, *Morus lompocanus*, *Osteodontornis orri* and *Cerorhinca dubia*. These and referred LACM specimens of several extinct species from southern California Miocene and Pliocene localities were used for comparison, and are noted in the text. Where specimens or casts were not available, comparisons were based on the literature. Recent skeletons from the LACM collections were also used for comparison.

LIST OF AVIAN SPECIES FROM LACM LOCALITY 1945

Order Procellariiformes

Family Diomedidae, albatrosses

Diomedea spp. (2 species)

Family Procellariidae, shearwaters and fulmar

Puffinus calhouni n. sp.

Puffinus priscus Miller ?

Puffinus sp.

Fulmarus hammeri n. sp.

Order Pelecaniformes

Family Pseudodontornithidae, extinct bony-toothed bird

Osteodontornis orri Howard ?

Family Sulidae, boobies and gannets

Microsula sp.

Morus lompocanus (Miller) ?

Miosula ? sp.

Sulidae, sp.

Order Anseriformes

Family Anatidae, geese

Presbychen abavus Wetmore

Anserinae, sp.

Order Charadriiformes

Family Alcidae, auklets, etc.

Alca sp.

Cerorhinca sp.

Aethia rossmoori n. sp.

Alcidae, sp.

Subfamily Mancallinae

Alcodes ulnulus n. gen. n. sp.

Praemancalla lagunensis Howard

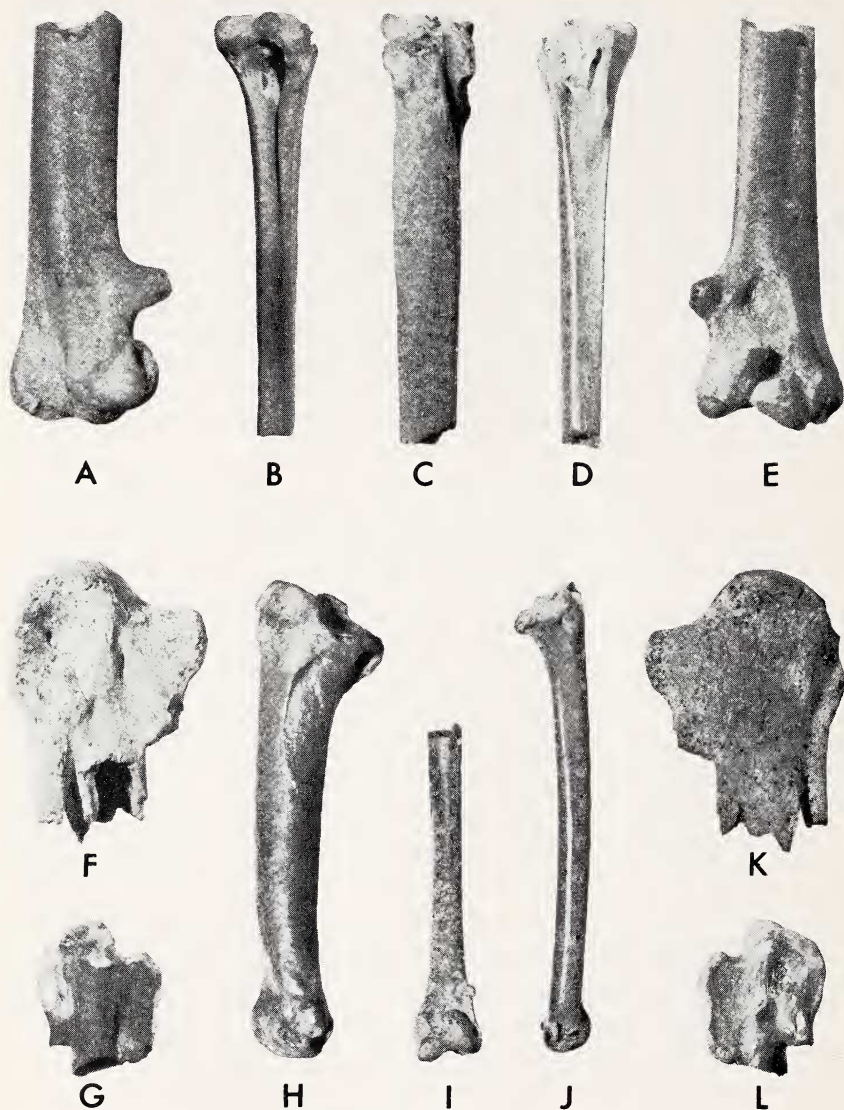


Figure 2. A-E *Puffinus calhouni* n. sp.; A and E, external and palmar views of type humerus; B, C, D, anterior, external and posterior views of referred tarsometatarsus (LACM 17582). F and K, internal and external views of type carpometacarpus of *Fulmarus hammeri* n. sp. G, H, L, *Alcodes ulnulus* n. sp.; G and L, external and internal views of referred carpometacarpus; H, internal view of type ulna. I-J, *Aethia rossmoori* n. sp.; I, referred humerus, palmar view; J, type ulna, internal view. All figures approximately X 2.

ANNOTATED LIST OF SPECIES
ORDER Procellariiformes

This order is the most abundantly represented. The 62 bones, assigned to two families and three genera, represent at least six species.

FAMILY Diomedaeidae
GENUS **Diomedea** Linnaeus
Diomedea spp.

A small fragment of the shaft of a tarsometatarsus near the proximal end (LACM 17550) is referred to the genus *Diomedea*. In size the specimen is similar to that element in *D. nigripes*, and is, therefore, too small to be assigned to *D. californica* Miller from the Miocene of Sharktooth Hill, and too large for *D. milleri* Howard from that same locality. There is little likelihood that the Recent *D. nigripes* is represented in a deposit of this age. The bone is too fragmentary to provide characters worthy of specific diagnosis.

A single pedal phalanx (LACM 18271), much larger than that of *D. nigripes*, and nearly equal in size to that of *D. exulans*, obviously represents a second fossil species, possibly assignable to *D. californica*.

FAMILY Procellariidae
GENUS **Puffinus** Brisson

Fifty-eight fragments are assigned to the genus *Puffinus*. The elements represented are: coracoid (4), scapula (3), humerus (9), ulna (14), radius (4), carpometacarpus (4), femur (1), tibiotarsus (3), tarsometatarsus (13), and one each of quadrate, cuneiform and wing phalanx.

Middle to Late Tertiary beds of southern California have already yielded six extinct species of *Puffinus*: *P. inceptor* Wetmore, *P. mitchelli* Miller and *P. priscus* Miller, all from the Middle Miocene of Sharktooth Hill; *P. diatomicus* Miller, from the Late Miocene diatomaceous shale of Lompoc; *P. felthami* Howard, from the Middle Pliocene of Corona del Mar; and *P. kanakoffi* Howard, from the Late Pliocene of San Diego.

Besides the California forms there are five species known from other North American and European deposits: *P. arvernensis* Milne-Edwards (Early Miocene of France), *P. micraulax* Brodkorb (Early Miocene of Florida), *P. aquitanicus* Milne-Edwards and *P. antiquus* Milne-Edwards (Middle Miocene of France), and *P. conradi* Marsh (Middle Miocene of Maryland).

The humerus (at least in part) is known in all of these species with the exception of *P. arvernensis*. The tarsometatarsus is known in *P. arvernensis*, *P. diatomicus*, *P. felthami* and *P. kanakoffi*; the ulna is tentatively recognized in *P. kanakoffi*, *P. mitchelli* and *P. priscus* (LACM coll. unrecorded). Several other elements of *P. kanakoffi* have been identified, and the proportions of some elements of *P. diatomicus* can be determined from skeletal impressions.

With a series of twelve Recent skeletons of *P. opisthomelas* as a basis of comparison, the various elements found in the present fossil collection and the incomplete skeletal representations for the other fossil species were assessed for possible similarities. It is clear that at least three species are present in the Laguna Hills material. One of these, new to science, is described here in honor of Mr. W. Earl Calhoun, who collected the type:

***Puffinus calhouni* n. sp.**

Fig. 2, A-E

Type: Distal end of right humerus, LACM 17508; collected by W. Earl Calhoun, Jan. 18, 1965.

Locality and Age: LACM 1945, Leisure World, Laguna Hills, Orange County, California. Late Miocene?

Diagnosis: Humerus near the minimum in size range of humeri of *Puffinus opisthomelas*; impression of brachialis anticus muscle deep, more round than oval, and not extending proximally beyond upper level of ectepicondylar process; surface of attachment of anterior articular ligament shorter and broader than in *P. opisthomelas*, slightly convex and facing more palmar than laterad; external condyle narrow.

Measurements: Breadth of distal end, 7.1 mm; distance from distal end to proximal edge of ectepicondylar process, 9.3 mm; external depth of distal end, 6.5 mm; internal depth of distal end, 8.0 mm; dimensions of shaft, 3.0 (breadth) x 6.0 (depth) mm.

Referred specimens: Distal end of left humerus, LACM 17539; proximal end of right ulna, LACM 17530; proximal two-thirds of left tarsometatarsus, LACM 17582; all found on the same date as the type. An incomplete distal end of a humerus, LACM 17540, and two fragments of tarsometatarsal shafts, LACM 17524, with portions of hypotarsus present, are tentatively assigned.

Ulna 17530 is near the minimum in size range of ulnae of *P. opisthomelas*. Distinctions are as follows: attachment of anterior articular ligament narrow and oval (more crescent-shaped in *P. opisthomelas*), arising at edge of internal lip of cotyla without intervening depression, and terminating distally well below level of lip of external cotyla; brachial impression beginning distal to aforementioned ligament attachment (not extending along the palmar side of the attachment); lip of external cotyla less abruptly set off from shaft, with a ridge connecting tip with shaft. Tarsometatarsus 17582 is heavier than that of *P. opisthomelas*, and further distinguishable by internal calcaneal ridge slightly mediad of internal surface of shaft; shaft deep externally, with anterior margin tending to curve mediad near proximal end. The tentatively assigned tarsometatarsi (LACM 17524) show the same mediad position of the internal calcaneal ridge and deep external side of shaft as in no. 17582, but the anterior margin is not so obviously incurved.

Measurements of referred specimens: Humerus 17539, breadth of distal

end, 7.1 mm; dimensions of shaft, 3.3 x 5.9 mm. Ulna 17530, breadth across proximal cotylae, 6.6 mm; depth from cotylae through olecranon, 7.7 mm; length of attachment of anterior articular ligament, 6.0 mm. Tarsometatarsus 17582, breadth of proximal end, 6.6 mm; breadth of shaft, 3.0 mm; depth of external side of shaft, 4.4 mm.

Discussion: Of the previously recorded fossil shearwaters, *P. diatomicus* most closely approaches *P. calhouni* in size. The humerus of *P. diatomicus* is immediately distinguishable, however, by the placement of the ectepicondylar process very high above the distal end, and proximal to the upper level of the impression of the brachialis anticus muscle. The tarsometatarsus of *P. diatomicus* resembles Laguna Hills specimen 17582 in the mediad position of the internal calcaneal ridge, but the internal contour of the proximal end is more flared proximally and laterally, resembling in this respect the condition in *P. griseus*; *P. calhouni* has the more symmetrical contours of *P. opisthomelas*. The characters of the humerus and tarsometatarsus of *P. diatomicus* are revealed in reverse casts made from the original skeletal impressions of the type and a referred specimen.

The humeri of *P. priscus* and *P. kanakoffi* are slightly broader than those of *P. calhouni*, and are distinguished further by the shallower impression of the brachialis anticus muscle, and a distinct pit at the lateral edge of the surface for the attachment of the anterior articular ligament; furthermore, in *P. priscus*, this surface faces more laterad than palmad. The distinction of *P. kanakoffi* is even more clearly shown in the tarsometatarsus, in which the hypotarsal region resembles that of *P. opisthomelas* in having the internal calcaneal ridge continuous with the internal border of the shaft, not inset mediad as in *P. calhouni*. The ulna of *P. kanakoffi* also resembles that of *P. opisthomelas*.

Six Miocene and Pliocene shearwaters are markedly larger than *P. calhouni* (*P. conradi*, *P. felthami*, *P. mitchelli*, *P. inceptor*, *P. antiquus*, *P. aquitanicus*); one is considerably smaller (*P. micraulax*). Although no measurements of *P. arvernensis* have been published, the tarsometatarsus, figured by Shufeldt (1896: pl. 24, figs. 1-2), appears to be much stockier than that of *P. calhouni*.

Puffinus priscus Miller ?

A fragment of a distal end of a humerus (LACM 17548) is slightly larger than the humeri of *P. calhouni* and equals the type of *P. priscus* (7.5 mm) in breadth across the condyles. The bone is broken through the brachial impression below the ectepicondylar process. The only diagnostic character remaining is the attachment of the anterior articular ligament, which is flat and rotated laterally as in *P. priscus*. An incomplete proximal section of ulnar shaft (LACM 17547) suggests a larger bird than the ulna referred to *P. calhouni*. It is distinguished further by (1) a more prominent distal tip of the attachment of the anterior articular ligament, which terminates higher on the shaft than in

P. calhouni, and (2) the presence of a prominent papilla close to the base of the lip of the external condyle. The specimen closely resembles an ulna recently collected at Sharktooth Hill, which I am assigning to *P. priscus*.

A proximal end of tarsometatarsus (LACM 17538) resembles this element of *P. calhouni* in the medial inset of the internal calcaneal ridge, but posteriorly the external foramen is greatly enlarged and lies in a deep depression; the specimen is slightly heavier than those assigned to *P. calhouni*, and may represent *P. priscus*. No tarsometatarsi of shearwaters have yet been found at Sharktooth Hill, the type locality of *P. priscus*.

Puffinus sp.

At least one additional species of shearwater is represented among the remaining specimens of *Puffinus*. An incomplete proximal end of a tarsometatarsus (LACM 17549), although similar in hypotarsal characters to *P. calhouni*, is distinctly larger (breadth of proximal end, 7.5 mm, approximately; breadth of shaft, 4.1 mm; depth of shaft, 5.0 mm). Of the larger North American fossil shearwaters, the tarsometatarsus is known only in *P. felthami*. The hypotarsal characters in *P. felthami* agree with those of Laguna Hills specimen 17549, but the shaft in the latter is deeper and heavier. A large distal end of tarsometatarsus (LACM 17523) from Laguna Hills may represent the same species as the proximal end. As the tarsometatarsus of *P. mitchelli*, *P. inceptor* and *P. conradi*, as well as those of the larger European species, cannot be compared, specific identification of these fragments is unwise.

The remaining 43 shearwater specimens in the collection probably belong either to *P. calhouni* or to the species tentatively identified here as *P. priscus*. Only a few of these are preserved in sufficient detail to present significant characteristics. Four incomplete coracoids (LACM 17528, 17529, 17531, 17534) are all broader through the triosseal canal than in Recent *P. opisthomelas*, the anterior (ventral) border below the furcular facet is straighter, and the furcular facet less pointed. All the coracoids are deeply concave through the triosseal canal, and in the three right ones a longitudinal groove, or trough, traverses the center of the area. In the left coracoid (LACM 17531) there is no central trough and the depressed area of the triosseal canal slopes directly to the anterior border. A single distal end of a femur (LACM 17516) is distinguished from that of *P. opisthomelas* in having a broader, deeper rotular groove (deeper, and broader than in *P. kanakoffi*).

GENUS Fulmarus Stephens

Two poorly preserved specimens represent the fulmars, a proximal end of carpometacarpus and a fragment of the external side of the distal end of a humerus. The carpometacarpus of *Fulmarus* can be distinguished from that of *Puffinus* by the blunt, poorly developed pisiform process set posterior to the center of the internal face of the carpal area, and by the more rugose contour

of the external crest of the trochlea. The fulmar humerus is distinguishable from this element in the shearwaters by the longer, straighter palmar border on the external side below the ectepicondylar process, and the less distally developed external condyle with a broader, straighter anconal surface. The two Laguna Hills fragments resemble comparable elements of *Fulmarus glacialis*, but are larger. They are described as a distinct species named for Michael K. Hammer, who collected the type.

***Fulmarus hammeri*, n. sp.**

Fig. 2, F, K

Type: Proximal end of left carpometacarpus, LACM 18262; collected by M. K. Hammer, Aug. 15, 1964.

Locality and Age: LACM 1945, Leisure World, Laguna Hills, Orange County, California. Late Miocene ?

Diagnosis: Closely resembling Recent *F. glacialis*, but approximately 20 per cent larger than the average of seven Recent specimens; process of metacarpal 1 relatively longer, and contour of external trochlear crest, posteriorly, at junction with metacarpal 3, smoother than in the Recent species.

Referred specimen: Distal fragment of external side of right humerus (LACM 18263) from the type locality, collected January, 1965. Similar to humeri of *F. glacialis*, but distinctly larger.

Measurements: Carpometacarpus, depth of proximal end from internal trochlear crest to tip of process of metacarpal 1, 13.1 mm (*F. glacialis* 10.1-11.2 mm, average 10.75); length of process of metacarpal 1, 8.8 mm (*F. glacialis* 6.1-7.0 mm; average 6.7 mm); breadth of trochlea, 5.5 mm approximately (*F. glacialis* 4.3-4.7 mm, average 4.5 mm). Humerus, distance from distal end to proximal edge of ectepicondylar process, 12.8 mm (*F. glacialis*, 10.6-11.6 mm, average 11.1 mm).

Remarks: The fossil carpometacarpus and humerus were not found together, but possibly some significance may be attached to the fact that both are among the few bones from locality 1945 that are of lighter color, and are seemingly somewhat less highly mineralized than most of the other specimens.

ORDER Pelecaniformes
SUBORDER Odontopterygia
FAMILY Pseudodontornithidae
Genus ***Osteodontornis*** Howard
Osteodontornis orri Howard ?

A fragment of a lower mandible (LACM 17557) bearing two bony tooth-like processes approximately 15 mm apart, with a small spine between them, represents an odontopterygiform bird. The specimen is narrower vertically than in the two known specimens of *Osteodontornis orri* (Howard, 1957; Howard and White, 1962), but possibly represents the extreme anterior end of

the jaw, which has not been clearly determined in the other specimens. The "tooth" processes measure 6.8 mm and 4.8 mm, respectively, across their bases. The smaller of the two is as tall as long and although slightly water worn, its pointed tip suggests that its height is nearly complete. The larger "tooth" is blunt and eroded, with a possible height of 8 mm or more. Neither "tooth" equals in size the major projections in the mandible of the type of *O. orri*, nor in that of the related *Pseudodontornis longirostris* (Spulski), whose origin and age are unknown. The tentative assignment to *Osteodontornis orri* is based on the previous records of the species as the only representative of the group from southern California.

SUBORDER Sulae

FAMILY Sulidae

Twenty-seven fragments are assignable to the Sulidae. The following elements are represented: coracoid (1), scapula (3), humerus (2), radius (5), carpometacarpus (6), femur (1), tibiotarsus (1), tarsometatarsus (3), quadrate (2), cuneiform (1), pedal phalanx (1) and sacral fragment (1). At least three species are represented by the five radii, and a fourth, and smaller, species is indicated by one of the humeri. The other specimens are tentatively grouped within these four species. None of the species can be definitely named.

Eight middle and late Tertiary species of sulids have been recorded from southern California: *Sula willetti* Miller, *S. pohli* Howard, *Morus vagabundus* Wetmore, *M. lompocanus* (Miller), *Miosula media* Miller and *Palaeosula stocktoni* (Miller) from the Miocene; *Sula humeralis* Miller and Bowman and *Miosula recentior* Howard from the Pliocene. Four are known from Florida: *Sula universitatis* Brodkorb, Miocene; *Sula guano* Brodkorb, *S. phosphata* Brodkorb and *Morus peninsularis* Brodkorb, Pliocene. Two are recorded from the Maryland Miocene: *Microsula avita* (Wetmore) and *Morus loxostylus* (Cope); the latter is also recorded from New Jersey. One species, *Microsula pygmaea* (Milne-Edwards), is recorded from the Miocene of France.

For the most part, the same elements cannot be compared between the Laguna Hills assemblage and the material from other localities. It would, therefore, serve only to confuse the record to attempt definite assignment of these fragmentary specimens. It is hoped that as more Tertiary bones become available, it will be possible to make a detailed analysis of the group. Such an analysis may well result in a revision of current generic usage among the fossils. The skeletal characters that separate *Morus* and *Sula* among living birds are not always distinct in the fossils, and do not hold true in all comparable elements.

GENUS *Microsula* Wetmore

Microsula sp.

A small humerus (LACM 17556) agrees in size with the type of *Micro-*

sula avita (Wetmore) and further conforms to Wetmore's (1938:22-23) description as follows: ectepicondylar process slight, internal condyle globular and projecting distinctly distal to the level of the external condyle, brachial impression slightly depressed, attachment of anterior articular ligament short and broad. The specimen differs from that of *M. avita*, however, as follows: olecranal fossa deeper and more round than oval, surface for attachment of anterior articular ligament as broad distally as it is proximally (Wetmore's illustration of *M. avita* shows this surface to narrow distally), and brachial impression more deeply depressed in its distal than in its proximal half.

A distal half of a carpometacarpus (LACM 17555) agrees with Wetmore's illustration (*op. cit.*, fig. 3) of this element assigned to *Microsula avita* in the shortness of the distal symphysis and the absence of pneumatic foramina. This fragment cannot be distinguished from the carpometacarpus assigned to *M. avita* by Wetmore. *Microsula* is characterized by the reduction of pneumaticity in comparison with living members of the family Sulidae, as observed primarily in the carpometacarpus, but presumably noted in the humerus as well. The Laguna Hills humerus has only one small pneumatic foramen in the olecranal fossa.

A small proximal end of a tarsometatarsus (LACM 17554) is possibly assignable to the same species as the humerus and carpometacarpus, but presumably to a slightly larger individual. The shaft has a narrow, deep excavation anteriorly, with heavy, rounded margins. The two foramina above the large, oval tubercle for the tibialis anticus muscle are inconspicuous and appear to be the only openings in the area, suggesting the reduced pneumaticity which characterizes the other elements. The intercotylar tuberosity is prominent as in *Sula*, as contrasted with *Morus*. The relationship between the middle and internal calcaneal ridges is closer to the condition found in *Sula*, although the posterior surface of the internal ridge has less medial extent.

The humerus (LACM 17556) indicates that the Laguna Hills species is not *Microsula avita*. From Wetmore's statement (1938:23) regarding the distinction of *M. pygmaea* from *M. avita* (smaller size and different confirmation of ectepicondylar area), it seems safe to assume that this distinction extends, as well, to the Laguna Hills specimen. The only other previously described sulid that could have been as small as the species here represented is *Sula willetti*. *S. willetti* is recorded from three Tertiary localities in southern California, all presumably of Late Miocene age. The possibility that the Laguna Hills specimens could be assignable to *S. willetti* cannot be overlooked. It should be noted that *Microsula* was originally established (Wetmore 1938:25) as a subgenus of *Sula*, characterized only by reduced pneumaticity of the bones. The characteristics of *S. willetti* that link it with *Sula* as contrasted with *Morus* do not rule out the possibility of relationship to *Microsula*. One characteristic of *S. willetti* that is not true of Recent *Sula* is the shortness of the ulna in proportion to the humerus. The presence or absence of pneumatic foramina,

and other details of individual elements cannot be determined from the impressions that provide the only records of *S. willetti*.

GENUS **Morus** Viellot
Morus lompocanus (Miller) ?

A well preserved distal end of a tibiotarsus (LACM 17570) has the relatively great anteroposterior depth that characterizes this element of *Morus* as distinguished from the broad, flat tibiotarsus of *Sula*. The fossil is larger in all dimensions than that of the only available Recent skeleton of *Morus bassanus*. The size suggests the possibility of allocation to *M. lompocanus*, known to be a bird of large size, although the tibiotarsus itself cannot be compared. The tibiotarsus of *Miosula media* Miller, which can be seen on a reverse cast of the type, is also of large size. Both this specimen, and the type of *Miosula recentior*, however, have greater lateral and distal thrust of the external condyle than in *Morus* and the specimen from Laguna Hills.

Two proximal ends of radii (LACM 17574 and LACM 18268) resemble *Morus* more closely than *Sula* in this element, but do not quite equal the dimensions of the radius of *M. bassanus* at hand. Their relationship to the tibiotarsus is questionable.

GENUS **Miosula** Miller
Miosula ? sp.

Nine specimens are water worn fragments that have adhering to them a highly indurated matrix distinctly different from the embedding sands from which the specimens were recovered. It is suggested that the bones may have been washed into the sands from an earlier deposit. The preservation is very poor, the water worn contours and hard matrix (that defies removal, and is itself water worn) obscuring many of the diagnostic characters. Elements represented are: coracoid (LACM 17569), radius (LACM 17568), carpometacarpi (LACM 17566 and 17579), tarsometatarsus (LACM 17565), femur (LACM 18269), two unnumbered quadrates and a sacrum. The coracoid, radius, proximal end of carpometacarpus (LACM 17566), and tarsometatarsus show some significant features.

The coracoid is worn along the external edge of the head so as to disguise the true contours in this area. Characters of the triosseal canal, scapular facet and ligamental attachment on the antero-internal side of the head resemble the coracoid of *Sula* as distinguished from that of *Morus*. In breadth across the triosseal area, it slightly exceeds this element in a Recent female adult specimen of *Sula dactylatra*, and is therefore, notably larger than any of the Miocene or Pliocene fossil species described in the genus *Sula*.

The proximal end of carpometacarpus (LACM 17566) is slightly smaller than in the Recent specimen of *S. dactylatra*. It differs from this element of both *Sula* and *Morus* in closer proximity of attachment of metacarpal 3 to the

trochlea, greater posterior curvature of metacarpal 3, and absence of pneumatic foramina. Pneumatic foramina are fewer in *Morus* than in *Sula*, and there is a slight tendency to posterior curvature of metacarpal 3 in *M. bassanus*. A somewhat closer similarity of the fossil to *Morus* than to *Sula* is, therefore, suggested.

The distal fragment of radius (LACM 17568) is also smaller than in *S. dactylatra* and bears distinctive characters that could be of generic significance. In angularity of the distal contour, the resemblance is closer to radii of *Sula* than of *Morus*, but differences are clearly marked. The ligamental prominence is more swollen, the shaft is relatively deeper and narrower, and the external contour of the shaft above the articular facet curves in abruptly and lacks the flangelike marginal projection found in *Sula*. Most distinctive, however, is a large, deep, oval depression centrally located, the abrupt margins of which, as well as its depth, suggest pneumaticity; actual openings, if present, are obscured by the hard, adhering matrix. The specimen is clearly distinct from the two distal ends of radii listed below under Sulidae sp., and its smaller size sets it apart from those represented by proximal ends tentatively allocated to *Morus lompocanus*.

The tarsometatarsus, a proximal half, has a relatively narrow shaft as in *Morus*, with a lateral dimension (taken immediately below the internal calcaneal ridge) approximately that of the tarsometatarsus of *M. bassanus* (narrower than that of *S. dactylatra*), but with a depth on the internal side at the same point on the shaft, 2 mm greater than in *M. bassanus*. Detailed contours of the proximal end are incomplete; the anterior portion is broken away so that the degree of prominence of the intercotylar tuberosity cannot be determined. Posteriorly, the position of the innermost calcaneal ridge is more medial with respect to the internal cotyla than in *Morus* (closer to *Sula*) and the second ridge is more definitely bridged to the first (also closer to *Sula*).

Because of the distinctive preservation of the nine bones, one is tempted to think of them as belonging to one species even though they were not actually associated. At least three of the elements (carpometacarpus, radius, tarsometatarsus) appear to be generically distinct from both *Sula* and *Morus*. The proportions of large coracoid and tarsometatarsus with relatively smaller radius and carpometacarpus suggest the possibility that *Miosula* may be the genus represented. The genotype of *Miosula*, *M. media* Miller (1925:115), is characterized by these proportions. The type of *M. media* is a skeletal impression in which only the tarsometatarsus can be compared with the Laguna Hills bones. This element from the two localities is the same in overall size and slender proportions. Unfortunately the details of the anterior side of the proximal end, which show in *M. media*, are lacking in the Laguna Hills bone, and characters of the posterior side are obscured in the matrix in the type of *M. media*.

Sulidae, sp.

Two distal ends of radii (LACM 17572 and 18264) differ from specimen no. 17568, tentatively assigned to *Miosula*. They differ also from Recent specimens of this element in *Morus* and *Sula* in the absence of pneumatic foramina; and in other particulars, as well, do not exactly conform to either of the Recent genera. The smoothness of the ulnar depression and the slight development of the ligamental prominence more nearly resemble the condition in *Morus* than in *Sula*. But there is less flare of the distal end, and the ulnar side of the shaft has a markedly angular apex extending to the distal facet. Although it is difficult to take exact measurements on these fossil specimens, they seem to fall within the size range of radii of *Sula leucogaster brewsteri*, and are distinctly smaller than those tentatively listed above under *M. lompocanus*, but too large to be assigned to *Microsula*. A complete cuneiform (LACM 17562), a fragment of an articular end of a scapula (LACM 17560), and a middle trochlea of tarsometatarsus (LACM 17575) all show characters closer to those of comparable elements of *Morus* than of *Sula*, but their fragmentary condition does not permit of definite allocation. All are notably smaller than comparable elements of *M. bassanus*, and only slightly larger than the maximum of four specimens of *S. leucogaster brewsteri*.

Three distal fragments of carpometacarpi (LACM 17558, 17561 and 17578) lack foramina in the distal symphysis, and thus differ from both *Sula* and *Morus*. They slightly exceed the maximum of *S. leucogaster brewsteri* in size.

ORDER Anseriformes
FAMILY Anatidae
GENUS **Presbychen** Wetmore
Presbychen abavus Wetmore

A fragment of the proximal end of a tarsometatarsus (LACM 17552) agrees in size with, and resembles in the qualitative characters preserved, the tarsometatarsus from Sharktooth Hill assigned to *Presbychen abavus* (Howard, 1966b:8). The characters are as follows: anterior face of shaft deeply depressed in region of proximal foramina, flattening toward internal side through area of attachment of tibialis anticus muscle, but internal border retaining a distinct ridge for a slightly greater distance distally than in the Sharktooth Hill specimen; external surface of shaft deep anteroposteriorly. Exact measurements cannot be made.

A femur (LACM 17553) also agrees, in such characters as are preserved, with the femur from Sharktooth Hill assigned tentatively to *P. abavus* (Howard, 1966b). Both femora are very poorly preserved and can be analyzed only in the most general manner: head large, upturned, neck well defined; greatest lateral extent of external contour of articular end nearly central with respect to anteroposterior dimensions, anterior edge of trochanter seemingly blunt,

lacking curved, pointed tip. The only accurate measurement possible is the anteroposterior dimension through the trochanteric crest, 16.6 mm. This is approximately 10 per cent less than in minimum specimens of *Cygnus olor* or *Olor columbianus*.

A scapula (LACM 17551) of a large anserine is also assigned to *Presbychen*, although specific allocation to *P. abavus* is doubtful as the specimen does not exceed this element of *Branta canadensis* in size. The scapula resembles this element in *Cygnus*, and is distinguished from that of *Branta*, or any other living goose, in the absence of a dorsal pneumatic foramen. It differs from the extinct *Eremochen*, in which the foramen is absent, in having a large, knoblike coracoidal tuberosity (suggestive of the condition in *Cygnus*) and a raised area in the posterodorsal region where the foramen would be. Cygnine characters have also been noted in the tarsometatarsus from Sharktooth Hill assigned to *P. abavus* (Howard, 1966b).

Anserinae, sp.

A distal end of a radius (LACM 18270) represents a small goose, no larger than *Branta nigricans*.

ORDER Charadriiformes

FAMILY Alcidae

Except for the flightless, mancallid auks, which are now recognized as a subfamily of the Alcidae (Brodkorb, 1967), the alcids are rare in the California fossil record. A single specimen, described as *Cerorhinca dubia* Miller, occurred in the Lompoc Miocene, and *Brachyramphus pliocenae* Howard and *Ptychoramphus tenuis* Miller and Bowman were described from the Pliocene of San Diego. Elsewhere in the United States records include *Miocepphus mcclungi* Wetmore (Maryland Miocene), *Uria antiqua* Marsh (North Carolina Miocene) and *Australca grandis* Brodkorb (Florida Pliocene). A single Pliocene species, *Uria ansonia* Portis, is recorded from Europe (Italy). The mancallids (*Mancalla californiensis* Lucas and *M. diegensis* (Miller)) occur in several Pliocene sites in California and are represented in the locality here under discussion by the species *Praemancalla lagunensis* Howard.

Besides the six bones of *P. lagunensis* previously recorded (Howard, 1966a), an additional 21 specimens of auklike birds are present in the collection from LACM locality 1945. The following elements are included: coracoid (6), humerus (3), ulna (7), radius (1), carpometacarpus (2), and tarsometatarsus (2). None is well preserved, but 12 show sufficiently diagnostic characters to be referred to two new species. The others seemingly represent another three or four species, but cannot be definitely assigned.

GENUS *Alca* Linnaeus

Alca sp.

A fragment of a right coracoid (LACM 18282) lacks the head and the

tip of the procoracoid, and is broken just below the connection of the procoracoid to the shaft. It closely resembles this element in *Alca torda* in development of the procoracoid and clearly defined coracoidal foramen, but is of slightly smaller size. It would be unwise to attempt description on so incomplete a fragment.

Humerus LACM 18283, which lacks the proximal end, resembles the humerus of *Alca torda* most closely in the tricipital grooves and the curvature of the anconal contour of the shaft near the distal end. The distal end is worn and incomplete, but the attachment of the anterior articular ligament appears to have been more projecting and more palmar in direction than in the Recent species. The bone is both shorter and stouter than the humerus of *A. torda*.

GENUS **Cerorhinca** Bonaparte **Cerorhinca** sp.

A proximal end of an ulna (LACM 18274) resembles this element of *Cerorhinca monocerata* in conformation, with a narrow, rather depressed brachial impression undercutting the prominence for the anterior articular ligament, and with a short olecranon. Each of these characters is, however, exaggerated in the fossil, and the size of the bone indicates that it represents a species of smaller size than *C. monocerata*. The Miocene *Cerorhinca dubia*, known only from the impression of the leg bones, was probably a bird of about the same size.

A small fragment of a shaft of humerus (LACM 18275) near the distal end may represent the same species.

GENUS **Aethia** Merrem

A complete ulna of very small size resembles this element in *Aethia* in the blunt olecranon and the small, basinlike depression between the olecranon and the external cotyla, delimited by a definite ridge externally. Other characters, however, distinguish the fossil ulna from the comparable element in living species of *Aethia*, and indicate that it represents an extinct form. This is the first fossil record of the genus. In naming the species, I take pleasure in honoring Mr. Ross Cortese who developed the senior citizen community at Laguna Hills under the name of Rossmoor Leisure World.

Aethia rossmoori n. sp.

Fig. 2, I, J

Type: Right ulna complete except for tip of olecranon; LACM no. 18948; collected by LACM party, Aug. 15, 1964.

Locality and Age: LACM 1945, Leisure World, Laguna Hills, Orange County, California. Late Miocene ?

Diagnosis: Close to *Aethia pusilla* in size, but shaft of ulna rounder, less bladellike; attachment of anterior articular ligament more prominently projected laterally; olecranon broken at tip, but seemingly even less developed than in *A. pusilla*; external crest of trochlea slightly less developed both proximally and in depth; carpal tuberosity prominent and forming a hook.

Measurements: Greatest length, 28.0 mm; least breadth of shaft, 1.7 mm; least depth of shaft, 2.0 mm; breadth across proximal cotylae, 3.9 mm; greatest breadth of distal end through carpal tuberosity, 3.1 mm; depth of external crest of distal trochlea, 3.2 mm.

Referred specimen: Left humerus, LACM no. 18949, collected on the same day as the type. The specimen resembles that of *Aethia pusilla* in the papillalike process at the proximal tip of an otherwise poorly developed ectepicondylar process. The shaft is even more rounded than *A. pusilla* and the attachment for the anterior articular ligament faces even more directly palmar than in the living species. Measurements: breadth of distal end, 4.1 mm; breadth and depth of shaft above ectepicondylar process, 2.5 mm in each dimension; least breadth of shaft, 1.8 mm, depth of shaft at same place, 2.3 mm.

Tentatively referred specimens: Distal half of ulna, LACM 18960, similar to type except carpal tuberosity seemingly less hooked. Proximal half of radius (LACM 18953) and distal half of carpometacarpus (LACM 18951) both of appropriate size, but too fragmentary for analysis.

Three fragmentary coracoids (LACM 18952 and 18954 (two)), all lacking the head, represent an auklet of the same small size as the other specimens. All differ from Recent individuals of *Aethia* in the more distally extended procoracoid, pierced by a clearly defined foramen. One character which distinguishes them from those Recent genera of alcids in which the procoracoid is well developed and the foramen present, is the position of the procoracoid and the glenoid facet in relation to the shaft. The fossils resemble *Aethia* in that the procoracoid arises at the internal edge of the shaft, and the glenoid facet faces posteriorly; in the Recent genera that have a foramen, the procoracoid arises slightly posterior to the internal border of the shaft, and the glenoid facet faces more externally, not directly posteriorly.

Alcidae, spp.

Five fragments cannot be generically assigned. Two coracoids (LACM 18276) appear to have a short procoracoid, either notched, as in some individuals of *Cephus*, or lacking a foramen entirely, thus differing from LACM 18282 assigned to *Alca*. The size is about that of the pigeon guillemot, *Cephus columba*. Both specimens lack the head.

A proximal portion of an ulna (LACM 18272) lacks the olecranon, and is badly eroded through the cotylae. It is distinctive in having a relatively broader brachial impression than in any Recent genus. The shaft depth is close to this dimension in *A. torda*, but the breadth is considerably greater. The

attachment of the anterior articular ligament is prominent and convex, and is undercut by the brachial impression along its palmar edge.

Two tarsometatarsal fragments (LACM 18273 and 18281) are close in size to tarsometatarsi of *Uria aalge*, but are too incomplete for identification.

Size alone suggests that at least two species are represented by these specimens. The coracoids suggest a bird close in size to *Cepphus columba*. The tarsometatarsi and ulna represent a larger form (or forms?).

SUBFAMILY Mancallinae

NEW GENUS *Alcodes*

Type Species: Alcodes ulnulus, n. sp. (*Alca*, auk; *odes*, similar to; *ulnulus*, small ulna).

Diagnosis: Ulna relatively short, with proximal breadth 18 per cent of length, and proximal depth 24 per cent of length; brachial impression well defined, its length 2 per cent greater than depth of proximal end, its breadth 39 percent of its length; contours of ligamental attachments and olecranon blunt. Carpometacarpus with anterior border of process of metacarpal 1 nearly straight; length of process 91 per cent of depth of proximal end; facet for phalanx 1 slightly distal to proximal symphysis; trochlea nearly flat across proximo-anterior surface, and narrowing posterodistally.

Alcodes ulnulus n. sp.

Fig. 2, G, H, L

Type: Complete left ulna, LACM 18277, collected by W. Earl Calhoun, December 24, 1964.

Locality and Age: LACM 1945, Leisure World, Laguna Hills, Orange County, California. Late Miocene ?

Diagnosis: See Generic Diagnosis.

Description: Ulna short and stocky with proximal and distal ends laterally compressed; shaft rounded on internal surface, tapering slightly in depth distal to center; olecranon deep but blunt; brachial impression short and broad, bordered towards its proximal end by the smoothly rounded prominence for attachment of the anterior articular ligament; markings for feather attachments clearly visible externally as six slightly raised papillae near anconal ridge, and as seven small depressions towards center of external surface of shaft; carpal tuberosity heavy and blunt, not projecting; lip of external cotyla blunt in palmar contour.

Measurements: Greatest length, 30.9 mm; breadth of proximal end, 5.7 mm; depth of proximal end through olecranon, 7.5 mm; depth of external side of distal trochlea, 5.4 mm; breadth across distal trochlea, 3.8 mm; length of brachial impression, 7.7 mm; greatest breadth of brachial impression, 3.0 mm; depth of shaft at distal tip of brachial impression, 4.5 mm, breadth of shaft at same place, 2.9 mm.

Referred material: Distal end of right ulna (LACM 18279); proximal

end of right carpometacarpus (LACM 18278); and, tentatively, proximal portion of right ulna lacking olecranon and complete contours of cotylae (LACM 18280). All specimens were collected at the type locality in December, 1964.

The distal end of ulna is so similar to the type that it could represent the same individual. The incomplete proximal half of ulna resembles the type in the short, broad brachial impression, placement of feather attachments and shape of shaft, but is at least 10 per cent larger than the type.

The carpometacarpus seemingly represents an individual of the same size as the type. Characters are as follows: process of metacarpal 1 elongated, proximo-distally with facet for phalanx 1 distal to proximal symphysis, and small in size; anterior border of process nearly straight; external crest of trochlea less proximally extended than in Recent alcids; distal tip of internal crest of trochlea merging into metacarpal 3 without marked notch; trochlea nearly flat across proximo-anterior surface, narrowing posteriorly; distal lobe of external crest greatly reduced, metacarpal 3 aligned with distal edge of internal crest of trochlea; pisiform process small. Measurements of carpometacarpus: breadth of trochlea, 3.8 mm; depth of proximal end through internal crest of trochlea and process of metacarpal 1, 8.0 mm; length of process of metacarpal 1, 7.3 mm.

Discussion: The proportions of the type ulna of *Alcodes ulnulus* are distinctive. The proximal breadth is greater than in *Ptychoramphus aleuticus*, the proximal depth approaches that of *Cephus columba*. But the length of the element falls far short of either species and more closely approximates that of the tiny Least Auklet, *Aethia pusilla*. The short, stocky bone suggests that *A. ulnulus* was progressing towards flightlessness. Such proportions of the ulna are not to be found in any living alcids. However, the ulna does not have the paddlelike proportions of the flightless *Mancalla*, or even *Pinguinis*, or its possible forerunner, *Australca grandis*.

The carpometacarpus also reflects the trend toward flightlessness. The elongated process of metacarpal 1, the smooth surface of the trochlea and reduction of the trochlear crests suggest a tendency towards the condition found in *Praemancalla*, but with less modification. As previously noted (Howard, 1966a), *Praemancalla* was less advanced in development of the paddlelike wing than *Mancalla*. On the basis of the characters of the carpometacarpus, *Alcodes* shows closer relationship to the mancallids than to the true alcids (see Howard, 1966a:3). However, characters of both the carpometacarpus and the ulna suggest a collateral, rather than a direct line with respect to *Praemancalla* and *Mancalla*.

***Praemancalla lagunensis* Howard**

The six specimens of this extinct species from LACM locality 1945 were all discussed in the type description (Howard, 1966a). The elements included are humerus, coracoid, carpometacarpus (2), scapula and fragment of lower mandible.

SUMMARY AND CONCLUSIONS

The 19 or more avian species from Laguna Hills locality LACM 1945 comprise a marine avifauna in which the Family Procellariidae predominates in number of specimens (60). The Sulidae and the Alcidae, each with 27, are next in abundance. Scant representation of the Anatidae (4), Diomedidae (2) and Pseudodontornithidae (1) complete the total identified avifauna.

Although in its entirety the avifauna does not relate to that of any one previously recorded locality, the forms included show closer resemblance to those of the Miocene rather than to those of the Pliocene. None of the species recorded from the marine Pliocene of Orange and San Diego counties is even tentatively recognized in the material from LACM locality 1945. On the contrary, the typical Pliocene genus of flightless auks, *Mancalla*, so abundantly represented in the San Diego deposits, and present, also, in the Corona del Mar beds and localities 65120 and 65121 of Leisure World, Orange County, is absent in the LACM 1945 avifauna and the Mancallids are represented by the related, but less highly specialized, genus *Praemancalla*.

Several identifications (*Morus lompocanus*?, *Miosula*? sp., and *Cerorhinca* sp.) suggest similarity with species from the Late Miocene Lompoc diatomite, but because of the great difference in preservation of material from the two localities, no definite identifications can be made. The possibility that *Sula willetti*, also described from the Lompoc beds, might be represented by the fragments here referred to *Microsula* sp. is noted. The most abundant species of Lompoc, *Puffinus diatomicus*, is, however, absent.

One species, *Presbychen abavus*, previously recorded only from the Sharktooth Hill Middle Miocene, is identified, and one of the shearwaters of that locality, *Puffinus priscus*, is tentatively recognized. However, the sulid representation of locality 1945 does not include, even tentatively, the most abundant species of the Sharktooth avifauna, *Morus vagabundus*. The bony-toothed bird, *Osteodontornis orri*, heretofore recorded from both Middle and Late Miocene in southern California, is tentatively listed in the Laguna Hills avifauna.

The avifauna as a whole corroborates the evidence afforded by the primitive *Praemancalla* (Howard, 1966a:8), indicating a Miocene (probably Late Miocene) age of deposition of the fossil-bearing strata at LACM locality 1945, Laguna Hills.

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